IN THE CLAIMS

1. (Previously Presented) A method of measuring network performance comprising:

generating one or more probe packets that each include a send time of day;

transmitting the one or more probe packets to a respondent address;

receiving performance probe packets back from the respondent address that include a receive time of day indicating when the probe packets were received at the respondent address; and

measuring the network performance by comparing the send time of day with the receive time of day in the received probe packets.

2. (Previously Presented) The method of claim 1 including:

receiving a delta time stamp representing an amount of time required by a network processing device associated with the respondent address to echo back the probe packets; and

measuring the network performance according to the send time of day, receive time of day and the delta time stamp.

3. (Previously Presented) The method of claim 1 including:

calculating a first difference between the send time of day and the receive time of day for a first one of the probe packets;

calculating a second difference between the send time of day and the receive time of day for a second one of the probe packets; and

calculating the difference between the first and second calculated differences as an inter-packet jitter performance measure of the network.

4. (Previously Presented) A method of monitoring performance of an Internet protocol (IP) network, the method comprising:

receiving a probe packet containing a send time of day (TOD) stamp for a sender of the probe packet;

calculating a receive (TOD) stamp corresponding to when the probe packet was received;

writing the receive (TOD) stamp into the probe packet; and

echoing the probe packet back to the sender to provide IP network performance analysis based upon the send TOD stamp and the receive TOD stamp.

5. (Previously Presented) A method of monitoring performance of an Internet protocol (IP) network, the method comprising:

generating a timing probe data packet to be sent over the network, the timing probe data packet containing at least a send time of day (TOD) stamp for a sender of the timing probe data packet;

sending the timing probe data packet over the network from the sender to a receiver;

analyzing the timing probe data packet contents including at least the send TOD stamp as a performance measure of the network;

at the receiver, writing data into the timing probe data packet, the written data including at least a receive TOD stamp, and

echoing the timing probe data packet by the receiver thereof, wherein the sender of the timing probe data packet performs said analyzing based upon the send TOD stamp and the receive TOD stamp.

6. (Original) The method of claim 5 wherein said generating is performed in such manner that the timing probe data packet further contains a send sequence stamp, wherein said writing further includes a receive sequence stamp, and wherein said analyzing is based further upon the send sequence stamp and the receive sequence stamp.

7. (Original) The method of claim 6 wherein said analyzing step includes first calculating the difference between the send TOD stamp and the receive TOD stamp as a latency performance measure of the network.

8. (Original) The method of claim 7 wherein said generating, sending and analyzing are repeated for at least two successive ones of such timing probe data packets, and wherein said analyzing step further includes first calculating the difference between the send TOD stamp and the receive TOD stamp for a first one of the successive ones of such timing probe data packets, second calculating the difference between the send TOD stamp and the receive TOD stamp for a second one of the successive ones of such timing probe data packets, and third calculating the difference between the first and second calculated differences as an inter-packet jitter performance measure of the network.

9. (Original) The method of claim 8 wherein said analyzing includes comparing the send sequence stamp and the receive sequence stamp as a packet loss performance measure of the network.

10. (Original) The method of claim 9 wherein said writing includes writing into the timing probe data packet at the receiver data further including a delta time stamp representing the amount of time the data packet resided at the receiver and wherein said first and said second calculating includes subtracting the contents of the delta time stamp from the calculated differences.

11. (Original) Apparatus for measuring data packet transmission timing characteristics through an Internet protocol (IP) network, the apparatus comprising:

a sender software program residing on a computer-readable medium at a network node, the sender software program generating a probe data packet to be sent over the network, the probe data packet containing at least a send time of day (STOD) stamp, the sender software program further transmitting the probe data packet to a respondent address in the network, and

a responder software program residing on a computer-readable medium at a network node, the responder software program receiving the probe data packet, placing therein at least a receive time of day (RTOD) stamp, and echoing the probe data packet by transmitting the modified packet back to said sender software program,

the sender software program further determining a difference between the RTOD and the STOD, whereby the determined difference represents data packet transmission timing through the network.

12. (Original) The apparatus of claim 11 wherein the responder software program resides at the respondent network address.

13. (Original) The apparatus of claim 11 wherein said responder software program resides at the same network address as does the sender software.

14. (Original) The apparatus of claim 11 wherein the probe data packet when generated by said sender software program further contains a send sequence number for a

present probe data packet representing the sequence in which plural ones of such probe data packets are sent, and wherein said responder software program further places in the received probe data packet a receive sequence number representing the last received probe data packet in sequence and wherein said sender software program then further compares the send sequence number and the receive sequence number to determine whether the probe data packets were received by said responder in the order the probe data packets were sent by said sender and if not then records the result of such comparison as a data loss.

15. (Original) The apparatus of claim 14 wherein plural ones of such probe data packets are generated and transmitted to the respondent network address, wherein the responder software program calculates a variance among plural instances of such first differences as a measure of inter-packet jitter.

16. (Original) A method for measuring data packet jitter in an Internet protocol (IP) network, the method comprising:

at a sender network address generating to a first data packet Pa probe field including a send-time sub-field, a receive-time sub-field and a delta-time sub-field;

at the sender network address first placing in the send-time sub-field the send time of day (STOD) indication;

from the sender network address sending the data packet including the probe field;

receiving the data packet including the probe field at a respondent network address;

second placing in the receive-time sub-field the receive time of day (RTOD) at the respondent network address;

echoing the data packet including the probe field back to the sender network address;

saving the echoed data packet in a memory at the sender network address;

repeating the generating, first placing, sending, receiving, second placing and echoing steps for a second data packet Pb; and

calculating data packet jitter based upon the STOD and the RTOD sub-fields for first and second data packets Pa and Pb.

17. (Previously Presented) A method for measuring data packet loss in an Internet protocol (IP) network, the method comprising:

at a sender network address generating a first data packet Pa probe field including a send-sequence-number sub-field;

at the sender network address first placing in the send-sequence-number sub-field a send sequence number representing a relative send timing indicator for the first data packet Pa;

from the sender network address sending the data packet including the first data packet Pa probe field;

receiving the data packet including the first data packet Pa probe field at a respondent network address;

second placing in a receive-sequence-number sub-field a receive sequence number at the respondent network address, the receive sequence number representing a relative receive timing indicator for the first data packet Pa;

echoing the data packet including the probe field back to the sender network address;

saving the echoed data packet in a memory at the sender network address; and

comparing the send-sequence-number sub-field with the receive-sequence-number sub-field at the sender network address to measure data packet loss.

18. (Original) For use in active-sampling measurement of network performance, an article of manufacture comprising a computer-readable medium containing a program, the program comprising:

instructions for generating one or more performance probe data packets for transmission over the network, each performance probe data packet being dedicated to network performance measurement, each probe data packet containing one or more defined timing and sequencing parameters including send time of day, receive time of day, send sequence number and receive sequence number;

instructions for transmitting the one or more performance probe data packets over the network to a respondent address in accordance with a predefined protocol to which software residing at the respondent address is programmed to respond in a predefined way; and

instructions for analyzing a response from the software resident at the respondent address in accordance with the predefined protocol with respect to the one or more defined timing and sequencing parameters to measure the performance of the network.

19. (Original) The program of claim 18, wherein said instructions for generating, transmitting and analyzing form a part of dedicated performance assurance software residing at a given network node and wherein the software residing at the respondent address modifies one or more of the defined timing and sequencing parameters within each received

performance probe data packet in accordance with the predefined protocol and then echoes the received-and-modified performance probe data packet back to the dedicated performance assurance software.

20. (Original) The program of claim 19, wherein the modifying of each received performance probe data packet in accordance with the predefined protocol and the echoing of the received-and-modified performance probe data packet are performed by dedicated performance assurance software residing at the respondent address.

21. (Canceled)

22. (Previously Presented) An article of manufacture comprising a computer-readable medium containing a program, the program comprising:

instructions for generating a timing probe data packet to be sent over the network, the timing probe data packet containing at least a send time of day (TOD) stamp for a sender of the timing probe data packet;

instructions for sending the timing probe data packet over the network from the sender to the receiver;

instructions for analyzing the timing probe data packet contents including at the send TOD stamp as a performance measure of the network;

instructions executed at the receiver for writing data into the timing probe data packet, the written data including at least a receive TOD stamp, and

instructions for echoing the timing probe data packet by the receiver thereof, wherein the sender of the timing probe data packet performs said analyzing based upon the send TOD stamp and the receive TOD stamp.

23. (Original) The program of claim 22 wherein said instructions for generating are executed in such manner that the timing probe data packet further contains a send sequence stamp, wherein said instructions for writing are executed in such manner that the data written into the timing probe data packet at the receiver further includes a receive sequence stamp, and wherein said instructions for analyzing are executed in such manner that the analyzing is based further upon the send sequence stamp and the receive sequence stamp.

24. (Original) Service assurance agent apparatus for measuring data packet transmission timing characteristics through an Internet protocol (IP) network, the apparatus comprising:

a sender generating a probe data packet to be sent over the network, the probe data packet containing at least a send time of day (STOD) stamp, said sender further transmitting the probe data packet to a respondent address in the network, and

a responder at a respondent address in the network, said responder receiving the probe data packet, placing therein at least a receive time of day (RTOD) stamp to produce a modified probe data packet, and echoing the modified probe data packet by transmitting the modified probe data packet back to said sender,

said sender further determining a difference between the RTOD stamp and the STOD stamp, whereby the determined difference represents data packet transmission through the network.

25. (Original) The apparatus of claim 24 wherein the probe data packet when generated by said sender further contains a send sequence number for the present probe data packet representing the sequence in which plural ones of such probe data packets are sent, and where said responder further places in the received probe data packet a receive sequence number representing the last received probe data packet in sequence to produce the modified probe data packet and wherein said sender further compares the send sequence number and the receive sequence number to determine whether the probe data packets were received by said responder in sequence and if not then records the result of such comparison as a data loss.

26. (Original) The apparatus of claim 25 wherein plural ones of such probe data packets are generated and transmitted to the respondent network address and received, modified and echoed by said responder, wherein said sender calculates plural instances of such differences and wherein said sender further calculates a variance among such plural instances of such differences as a measure of inter-packet jitter.

27. (Original) The apparatus of claim 25 wherein said sender includes one or more comparators for performing such comparison.

28. (Original) The apparatus of claim 25 wherein said sender includes at least one subtractor for determining such difference and at least one comparator for performing such comparison.

29. (Original) The apparatus of claim 24 wherein said sender includes one or more subtractors for determining such difference.

30. (Canceled)

31. (Previously Presented) A method of measuring network performance comprising:

receiving at a given network address one or more performance probe data packets transmitted from a sender node address in the network, each performance probe data packet being dedicated to network performance measurement and each performance probe data packet having a defined receive time of day (RTOD) field therein;

in accordance with a predefined protocol modifying each performance probe data packet by placing in the defined RTOD field thereof the receive time of day of the corresponding performance probe data packet to produce one or more modified performance probe data packets;

echoing each modified performance probe data packet back to the sender node address in the network, in which each performance probe data packet further has a defined delta time field therein, wherein said modifying is performed by further placing in the defined delta time field data substantially representative of an amount of time elapsed while performing said modifying and said echoing of the corresponding performance probe data packet.

32. (Previously Presented) The method of claim 31 in which each performance probe data packet further has a defined receive sequence stamp field therein, wherein said modifying is performed by further placing in the defined receive sequence stamp field a receive sequence stamp representing the order in which each performance probe data packet is received at the given network.

33. (Currently Amended) A network processing device, comprising:

a processor transmitting one or more packets to a respondent address, the packets each including a send time of day indicating ~~associated with~~ when the packets were sent;

the processor receiving modified packets echoed back from the respondent address that include a receive time of day ~~associated with~~ indicating when the packets were received at the respondent address; and

the processor measuring network performance by ~~comparing~~ determining a difference between the send time ~~with~~ of day and the receive time of day in the received packets whereby the determined difference represents data packet transmission timing through a network.

34. (Currently Amended) The network processing device according to claim 33 wherein the processor receives a delta time stamp in the received packets identifying an amount of time required at the respondent address to process the packets, the processor measuring the network performance according to the send time of day, receive time of day and the delta time stamp.

35. (Currently Amended) The network processing device according of claim 33 wherein the processor calculates a first difference between the send time of day and the receive time of day for a first one of the packets, calculates a second difference between the send time of day and the receive time of day for a second one of the packets, and calculates a difference between the first and second calculated differences as an inter-packet jitter performance.

36. (Previously Presented) A network processing device according to claim 33 wherein the processor generates packets including send sequence numbers identifying a transmit order for transmitting the multiple probe packets and receives back at least some of the packets that include receive sequence numbers identifying a receive order that the packets were received at the respondent address, the processor comparing the send sequence numbers with the receive sequence numbers to measure packet loss.

Cancel claims 37-44